DATA TRANSMISSION BY WATERMARK PROXY

Related Application Data

This application is a continuation-in-part of copending application _____,
filed January 26, 2000, entitled Data Transmission by Watermark Proxy, attorney docket
60099, which is a continuation-in-part of copending application 09/473,396, filed
December 28, 1999 entitled Watermark-Based Object Linking and Embedding, the
disclosure of which is attached as Appendix A. This application is also a continuation-in-
part of copending application 09/476,686, filed December 30, 1999, entitled Watermark-
10   Based Personal Audio Appliance, the disclosure of which is attached as Appendix B.
This application is also a continuation in part of copending application 60/134,782, filed
May 19, 1999, the disclosure of which is attached as Appendix C.
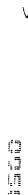
Field of the Invention

15   The present invention relates to data transmission, and more particularly relates to
use of watermarks as proxies for data in transmission.

Summary of the Invention

As detailed in the assignee's prior applications, including 60/134,782, 60/141,538,
20   and 09/343,104, digital watermark technology has numerous applications beyond its
traditional role of simply communicating copyright information. One futuristic view
foresees that all "content" should be watermarked, thereby enabling a great variety of
operations and transactions whenever watermarked content is processed by digital
devices equipped with watermark recognition and reading technology. All physical
25   media objects can thereby be inherently and persistently digitally-enabled, permitting
greatly simplified access to networks and execution of local and remote applications.
The continuing growth of the Internet and beginnings of trends toward pervasive
computing signal an opportunity to radically change the relationships between traditional
media content and digital processing environments.

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In this specification, content refers not just to electronic audio, image, and video files, but also includes the content aspects of physical objects and media, e.g., artwork, patterns, and labels on product packaging, concert tickets, etc.

In accordance with a preferred embodiment of the present invention, the
5   processing of watermark data as pointer to shared resources is sometimes used in lieu of transmitting from point to point the object with which it is associated, thereby gaining efficiencies in speed and bandwidth.

This and other features and advantages of the present invention will be more readily apparent from the following detailed description, which proceeds with reference
10   to the accompanying drawings.

Brief Description of the Drawings

Fig. 1 is a diagram illustrating a network environment in which principles of the present invention may be employed.

15   Fig. 2 is a flow chart illustrating aspects of one embodiment of the present invention.

Fig. 3 is a flow chart illustrating aspects of another embodiment of the present invention.

Fig. 4 is a flow chart illustrating aspects of yet another embodiment of the present
20   invention.

Detailed Description

Referring to Fig. 1, consider an exemplary network 10 linking two devices – a first device 12 associated with an originating user, and a second device 14 associated
25   with a recipient user. The first device 12 is coupled to the network through a relatively low bandwidth channel, whereas the second device 14 is coupled to the network through a relatively high bandwidth channel. (For example, the first device may be an internet-capable cell phone having low resolution-, still image only- capture capabilities, providing a 9600 baud data channel, or it may be a home PC, with an associated PC or
30   digital single shot camera, coupled to the internet with a 28.8 kbps modem. The second

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device may be a computer coupled to the internet through a 1.45 megabit per second T-1 line, a cable modem, etc.) The network 10 connecting the two devices includes various links – narrow bandwidth at some parts (e.g., 16), very broadband at other (e.g., internet backbone 18), etc.

5   Assume the user of device 12 encounters a printed image, e.g., an advertisement in a magazine, that may be of interest to the user of device 12. Using an imaging device (e.g., a CMOS- or CCD-camera built into a cell phone, a flatbed scanner connected to a PC, etc.), device 12 captures an image of the advertisement.

In prior art techniques, the image captured by device 12 would have been sent to
10   device 14 over the network; the image received by the second device would be exactly the image sent by the first device.

In accordance with one embodiment of the invention, device 14 receives a better image than that sent from device 12. In one such embodiment, device 14 receives the image data captured by device 12. Device 14 recognizes that the image includes a
15   watermark hidden within the image data, and decodes same. The watermark payload includes an index by which a copy of the image can be accessed from a server 20 on the internet or other storage medium. With this index, the second device 14 queries the server 20, which returns the image corresponding to this watermark index (in this case, the advertisement) back to the second device 14. The image provided by the server can
20   be higher resolution or pristine, i.e., it has no artifacts left from scanning at device 12, etc. Such a procedure is shown by the flowchart of Fig. 2.

The watermark payload identifying the sensed image can as long or as short as the application requires. Typically, payloads of between 16 and 64 bits are used, although this is not essential. Shorter payloads have the advantage that they can be more robustly
25   encoded while maintaining a fixed degree of image quality; longer payloads offer a greater universe of identifiers with which the image can be labeled. Illustrative watermarking technology is detailed in the assignee's patent 5,862,260, and in copending application _____, filed February 14, 2000, entitled Watermark Embedder and Reader (attorney docket 60112). A great variety of other watermarking arrangements may

be used, including those proposed in patents 5,930,369, 5,933,798, 5,664,018, 5,825,892, 5,940,429 and 5,889,868.

In accordance with another embodiment of the invention (Fig. 3), the bandwidth bottleneck imposed by narrowband channel 16 (through which device 12 is coupled) is

5   obviated by employing a watermark as a proxy for an image. In such an arrangement, the image data captured by device 12 is decoded, and a watermark payload hidden in the image is extracted. (This can be performed by hardware or software available in device12, e.g., a cell phone microprocessor, a desktop computer, dedicated decoder circuitry, etc. Alternatively, this decoding can be done remotely from device 12, but

10   before device 14, e.g., by a smart router in the intervening network. In the following discussion, decoding in the device 12 is assumed.) Instead of transmitting the image data over the network, the watermark decoding device (e.g., device 12) simply transmits the watermark payload (or a part thereof). On receipt of the payload, device 14 again queries the server 20, and obtains the image (and/or additional content or functionality, as

15   detailed below) , corresponding to that watermark. The image is obtained over the high-speed channel(s) between the server and the second device; the low bandwidth channel linking the first device conveys just the low bandwidth watermark payload information.

By building filters into the low bandwidth devices, upon recognition of a class of watermarks indicating availability of the image as a shared resource, or upon user

20   selection of "transmit only watermark data", the image [or content associated with it via the watermark] can be made available to the message recipient via more capable transmission means.

A variant of the foregoing does not transmit the watermark payload to the second device 14. Instead, the payload is dispatched by the first device 12 (or the smart router)

25   directly to the server 20, with instructions that the corresponding desired image be sent to the second device 14. Such an arrangement is shown in Fig. 4.

In some applications, the media delivered by the server may be richer than the simple image captured by device 12. For example, the watermark payload in the image captured by device 12 may index one or more files on server 20 that includes video,

30   animation, sound, executable applications, aplets (e.g., JAVA, ActiveX) etc ("enhanced

content"). Thus, scanning of a magazine ad at one device can prompt delivery of a video, a Macromedia ShockWave presentation, etc., to the second device.

In some embodiments, the second device 14 identifies to the server 20 its media-playback capabilities. The server 20 can then respond to a watermark-based query with media appropriate to that particular media consumer.

One way the media capabilities of device 14 can be indicated to server 20 is by a data word comprising flag bits, with each set "1" bit indicating a capability. A simplified 8-bit capability word may be as follows:

Bit	Capability
0	GIF file display
1	TIFF file display
2	JPEG filed display
3	AVI movie display
4	WAV sound
5	RealAudio sound
6	MP3 sound
7	WindowsMedia

The data comprising this word may be automatically compiled on device 14, e.g., from the operating system database with which programs are registered on installation (the Registry database in Windows).

If device 14 sends the capability word 10101100 to server 20, the server knows the device 14 supports GIF and JPEG imagery (but not TIFF), and RealAudio and WAV sound (but not MP3 or WindowsMedia).

If server 20 has media content corresponding to the queried watermark in several supported formats, it can deliver certain ones according to a priority order (e.g., send JPEG if supported; else send GIF if supported; else send TIFF if supported).

If the server 20 only has media in a format not supported by the second device 14 (e.g., TIFF in the foregoing example), the server may invoke a conversion routine to perform an on-the-fly conversion to a supported media type (e.g., JPEG) prior to sending to the second device 14.

If the watermark index is provided by the second device 14 (rather than directly from the first device 12), the capability data word can accompany the index.

If the watermark index is provided directly from the first device 12, the server can solicit from the second device 14 a data capability word before responding to the query.

5   Alternatively, the server can keep, on-file, a database detailing the media capabilities of all known media consumers, and can tailor its query response according to such profile. (The second device 14 can be arranged to automatically inform server 20 of updates to its capability, e.g., each time a new media playback application is registered in the registry database.)

10   If the server 20 does not know, and cannot discern, the media capabilities of the second device 14, it can provide media in a default form that is most likely to be acceptable (e.g., JPEG, if the content captured by the first device 12 is imagery).

From the foregoing description, it will be apparent that embodiments of the present invention provide various advantages over the prior art. One is the dispatch of

15   high bandwidth enhanced content using a low bandwidth channel. Another is the receipt of higher-quality data than that originally captured. Another is delivering applications via low bandwidth channels to recipients by capturing images or watermark data from media content that serve as proxies for the applications.

Having described and illustrated the principles of our invention with reference to

20   a specific embodiment, it will be recognized that the principles thereof can be implemented in other, different, forms.

For example, while the invention has been described with reference to images, the same principles are equally applicable to video and audio.

Similarly, while the foregoing description has made reference to transmitting the

25   watermark, in many implementations only a part of the watermark need be transmitted. (The watermark may include error correcting information, or other data, not necessary to identify the corresponding data on the server 20.)

Still further, while the detailed embodiment contemplated a still or video camera system for first device 12, much of the functionality of such an image capture system

30   isn't essential to the present invention. Instead, an input device that serves a simpler

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"watermark capture" function may be used instead. Such a device can omit, e.g., hardware or software components associated with pixel interpolation (commonly used to achieve a desired virtual resolution), formatting (e.g., to provide output in JPEG form), etc. Such components serve useful functions when the resulting imagery is to be

5   displayed or printed, but are superfluous – or detrimental – when the image data is simply to be decoded to extract watermark data.

While the invention is illustrated with reference to steganographic watermark technology for identifying the initial content (i.e., that sensed by device 12), other technologies can alternatively be used. These include data glyphs, 1- and 2-D barcodes,

10   magnetic ink, RF ID tags, UV or IR markings, etc.

While the detailed embodiment contemplated a single server 20 to serve as the repository of content corresponding to watermarks, in other embodiments such a server is implemented in distributed fashion. In some embodiments, one server may act as a default repository, and can dispatch queries to other servers if the first server cannot

15   provide the requested data. Caching of frequently-requested content can be provided at various locations through the network. Additional details on such network configurations can be found in application 09/343,104.

As is familiar to those skilled in the arts, the foregoing methods may be performed using dedicated hardware at devices 12, 14 and 20, and/or through use of

20   processors programmed in accordance with firmware or software, etc. In the latter case the processors may each include a CPU and associated memory, together with appropriate input and output devices/facilities. The software can be resident on a physical storage media such as disks, and can be loaded into the processors' memory for execution. The software includes instructions causing the CPU to perform the various

25   processes detailed above.

To provide a comprehensive disclosure without unduly lengthening this specification, applicant incorporates by reference the patents and applications cited above.

In view of the wide variety of embodiments to which the principles of our invention can be applied, it should be recognized that the detailed embodiments are illustrative only and should not be taken as limiting the scope of the invention. Rather, we claim as our invention all such embodiments as may come within the scope and spirit of

5   the following claims, and equivalents thereto.